Geological Society of Pennsylvania, in which is a most interesting "Critical notice of various organic remains discovered in North America," by Dr. Harlan. At p. 89, is the following:

"The bones of one species of shark, upwards of forty feet in length, allied to the Carcharias, have occasionally been found in several localities. In Cuvier's Theory of the Earth, by S. L. Mitchell, p. 400, it is stated, 'The skeleton of a huge animal was found on the bank of the Meherrin river, near Murfreesborough, N. C. It was dug out of a hill distant sixty miles from the ocean. Captain Neville and Dr. Fowler, who visited the spot, gathered the scattered vertebræ and laid them in a row thirty-six feet in length. If to this the head and tail be added, the animal must have been fifty feet or more in length, &c. We have recognized them as the remains of a gigantic species of shark.'"

He refers to other specimens, indicating sharks of forty feet or more in length; but this will, I doubt not, be sufficient to show that it is quite probable the fish seen by Lieut. Foley and the *chacon* of the Bay of Manilla may be individuals of the same family as those only known to us as yet by their fossil remains.

IX.—*Rules for Calculating the Lengths of the Drop-bars of Suspension Bridges, the Length and Deflection of the Chain, Rise of the Roadway, &c. By Captain* J. Thomson, *Engineers.*

The application of the following problem in statistics, to find the length of the drop-bars and links of a suspension bridge, has, I believe, the merit of originality; while it will be found extremely convenient in practice, in determining at once the requisite proportions, and obviating the necessity of after adjustment, which will always occur where the curve of such a bridge is assumed as a true catenarian.

If a be the angle of suspension,

b the length in feet of one of the links of the chain,

d the number of drop-bars in each chain; then the tangent of the angle a, divided by one-half $d. = n = \frac{2 \text{ Tan. } a}{d}$ is the constant difference between the tangents of the angles formed by the links of the chain with the horizon. These tangents will be as follows: upper link $= \text{Tan. } a$, 2nd $= \text{Tan. } a - n$, 3rd $= \text{Tan. } a - 2n$ &c. and the lowest $= \text{Tan. } a - \frac{d}{2} n$. The sines to radius b, corresponding to these angles, are the differences of the lengths of the drop-bars; and the cosines of these angles are the horizontal distances between the drop-bars, or the spaces which each link of the chain occupies in the span of the bridge. If therefore the sum of these cosines, multiplied by the radius b, be deducted from the span of the bridge, the difference will be the length of the horizontal space occupied by the two upper links; and half of this space, multiplied by the secant of a, will be the length of one of those links. The sum of all the links will be the length of the chain. The sum of the differences of the drop-bars, added to the deflection of the upper link, will be the total deflection of the chain. The roadway may be made to rise with a fair curve, by making the rise bear a certain proportion to the fall or deflexion of the chain.

The sum of the deflexion of the chain, the length of the centre drop-bar, and the rise of the road, will be the height of the point of suspension at the standard.

Example.

$a = 15° =$ angle of suspension.

$b = 5$ feet $=$ length of each link.

$d = 17 =$ number of drop-bars.

98.625 = distance between the points of suspension.

3.5 feet = length of centre drop-bars.

The rise of the road $= \frac{1}{5}$ the deflection of the chain.

$$\text{Tan. } a = .2679492 \quad - n = \frac{2 \text{ Tan. } a}{d} = \frac{.535898}{17} = .0315234.$$

1	2 Tang. of deflection	3 Cosines of deflec-tion.	4 Sines of de-flection	5 Differ. of drop-bars in ft.	6 Rise of Roadway.	7 Length of drop-bars.
Upper 1st link, ...	.2679492	....	.2588	2·5418	.5083	
1st drop-bar, ...						9.4580
2nd, ...	.2364258	.9731	.2301	1·1505	.2301	
2nd, ...						8.0774
3rd, ...	.2049024	.9796	.2007	1·0035	.2007	
3rd, ...						6.8732
4th, ...	.1733790	.9853	.1708	.8540	.1708	
4th, ...						5.8484
5th, ...	.1418555	.9901	.1404	.7020	.1404	
5th, ...						5.0060
6th, ...	.1103321	.9939	.1096	.5480	.1096	
6th, ...						4.3484
7th, ...	.0788087	.9969	.0785	.3925	.0785	
7th, ...						3.8774
8th, ...	.0472853	.9988	.0472	.2360	.0472	
8th, ...						3.5942
9th, ...	.0157618	.9998	.0157	.0785	.0157	
Centre drop-bar, ..						3.5000

7.9175 = sum of the cosines multiplied by
5 = × b

39.5875 = horizl. dist. between drop-bars.
49.3125 = ½ span.

9.5250 = difference.

1.0352 × secant of 15°.

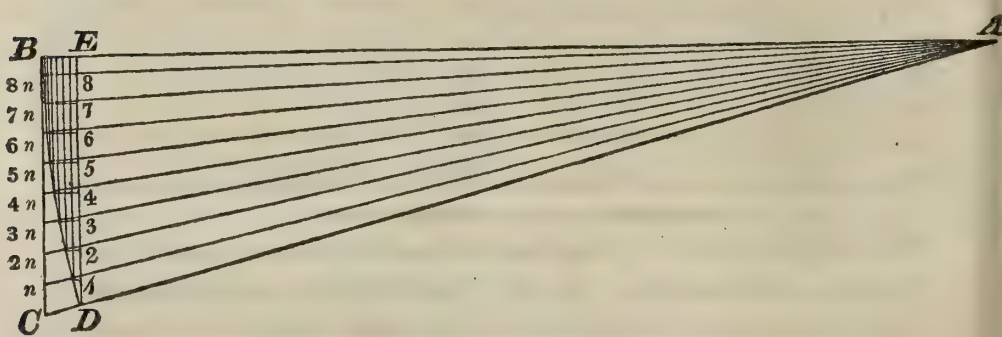
9.8602 = length of upper link.
.2588 = × sine of deflexion 15°.

2.5418 = deflection of upper link.

ft. in. ft. in.
5 × 16 + 9.8602 × 2 = 99.7204 length of chain.
The sum of column No. 5 = 7.5068 deflection of ditto.
Ditto No. 6 = 1.5014 rise of roadway.
7.5068 + 1.5214 + 3.5 = 12.5082 height of the point of suspension at standard.

N. B. Column 5 is found by multiplying column 4 by 5 feet.
Column 6 is one-fifth of column No. 5.
Column 7 is equal to columns 5th + 6th + 3 .5 feet.

The geometrical construction of this problem will answer as a proof to the foregoing rule, and will be of assistance in making plans of suspension bridges.



In the right-angled triangle ABC make the angle A = 15° = angle of suspension, and the side AB = 5 feet = length of one link of the chain. Divide the side CB into as many spaces, commencing at C, as there are drop-bars in $\frac{1}{2}$ the space = $8\frac{1}{2}$ spaces, and join A*n* A 2 *n*, &c. From the centre A with the radius AB describe the arc BD, and complete the lines shewing the sines and cosines of the angles formed by the line AB and the radii A*n*, A 2 *n*, A 3 *n*, &c. Then as these radii are parallel to the links of the chain, the sines of the angles E 1, E 2, E 3, &c. are the differences between the lengths of the drop-bars 1, 2, 3, 4, &c. and the cosines of these angles are the spaces which the links of the chain occupy in the space of the bridge. Supposing *n* = length of the centre drop-bar, the other drop-bars will be as follows :

Centre bar *n*.
8th, *n* + E 8.
7th, *n* + E 8 + E 7.
6th, *n* + E 8 + E 7 + E 6, and so on. This does not include the rise of the road, however, which is an arbitrary quantity.